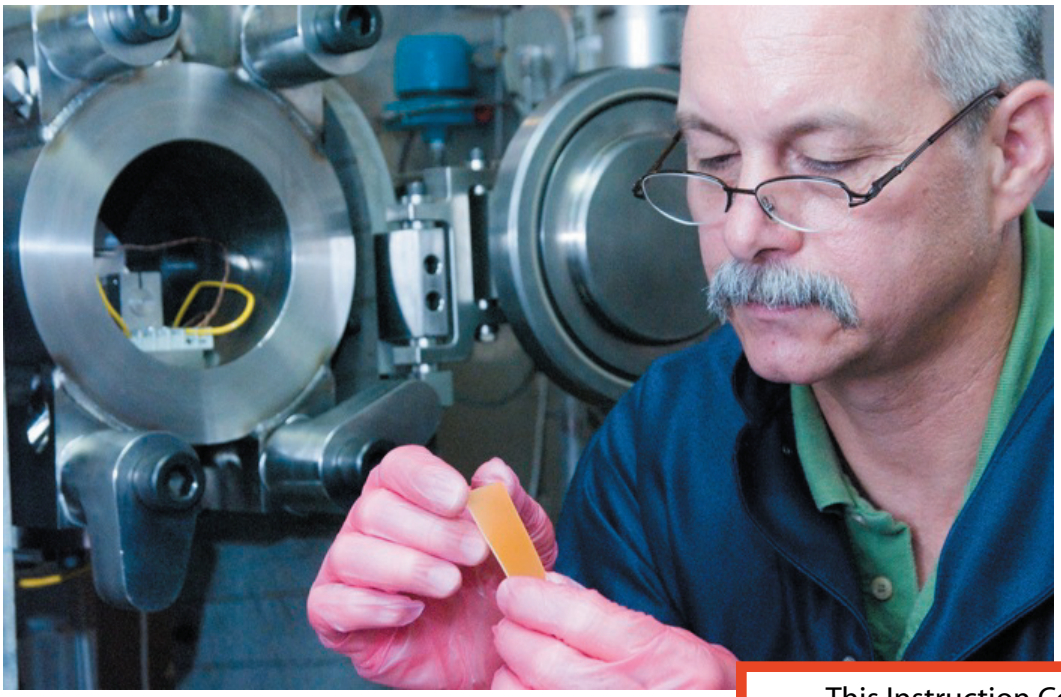
# Multimodal Friction Ignition Testing

## (Any Standard for Reference?)





! This Instruction Contains Descriptions of HAZARDOUS OPERATIONS !

Materials and Processes Laboratory
Materials Test Branch, Building 4623

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, AL 35812

| Release Authority | Name | Title | Organization | Date |
|---|---|---|---|---|
| Office of Primary Responsibility | _____ | Materials Test Branch Chief | EM10 | _____ |
| | _____ | Industrial Safety | QD50 | _____ |

| Revision | Date | Originator | Description | Affected Pages |
|---|---|---|---|---|
| Baseline | TBD | Eddie Davis | | |



This document baselines the EM10 Organizational Work Instruction (OWI) for performing Multimodal Friction Ignition tests in Marshall Space Flight Center's (MSFC's) Building 4623. Any deviation to this procedure shall be approved by the test engineer via an approved test plan. Any changes to the test equipment shall be noted on the tester maintenance log and approved by the test engineer. It is the responsibility of the test engineer to obtain NASA Contracting Officer's Technical Representative (COTR) approval where necessary for changes to the test equipment.

Any change to this OWI shall be submitted to and approved by the Materials Test Branch Chief, EM10. Revisions may also be submitted to the concurring organizations listed below for review and concurrence by memo. The original OWI and all changes shall be maintained by EM10. Any change to materials used requires a change to mechanical drawings, in addition to Chemistry Team Leader approval. All documentation shall be approved by the appropriate persons mentioned above and incorporated into the OWI before operation of the reconfigured test equipment can resume.

Concurring organizations:
Building 4623 Test Operations Contractor
Chemistry Team Leader
Environmental Health, AD60M

## Contents

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# 1.0 Scope

## 1.1 Scope

The scope of this operating instruction is (standard) Test ___, Multimodal Friction Ignition Test, as performed in Building 4623 at Marshall Space Flight Center.

## 1.2 Purpose

The purpose of the Multimodal Friction Ignition Test ___ is to _____ _____.

## 1.3 Applicability

This instruction applies to the Chemistry Team, Materials Test Branch, of the Materials and Processes Laboratory.

## 2.0 Applicable Documents

ASTM D 2512-82. *Standard Test Method for Compatibility of Materials with Liquid Oxygen (Impact Sensitivity Threshold and Pass-Fail Techniques).* 1982.

EM10-OWI-CHM-042. *Test Sample Preparation for Testing in Building 4623.*

EM10-OWI-CHM-050. *Building 4623 Guidelines for Test Operations*.

EM10-OWI-CHM-051. *Receipt, Handling, Prioritizing, and Data Requirements of Samples Submitted for Testing in Building 4623 of the Materials and Processes Laboratory*.

To be updated.

EM10-OWI-CHM-058. *Chemical Hygiene Plan for Building 4623.*

MPD 1840.3. *MSFC Respiratory Protection Program*.

MPR 1040.3. *MSFC Emergency Plan*.

MPR 1840.2. *MSFC Hazard Communication Program*.

MPR 8715.1. *MSFC Safety, Health, and Environmental (SHE) Program*.

MSFC-SPEC-164B. *Specification for Cleanliness of Components for Use in Oxygen, Fuel, and Pneumatic Systems.*

MWI 3410.1. *Personnel Certification Program*.

MWI 8621.1. *Close Call and Mishap Reporting and Investigation Program*.

NASA-STD-6001. *Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion.*

NHB-8060.1B. *Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion.*

**Note:** Always reference the current version of an applicable document.

# 3.0 Definitions

## 3.1 Definitions

TBD.

## 3.2 Acronyms

TBD.

# 4.0 Instructions

All operations of this equipment shall be conducted using the applicable documents referenced above (section 2). All data and test results shall be recorded on form EM10-F-CHM-0xx, the Multimodal Friction Ignition Test Data Sheet (section 7.2, Figure ___). A summary of pertinent test information and test results shall be compiled in a memorandum, signed by the test organization management, and mailed to the test requester.

## 4.1 Sample Preparation

The *sample preparation technician* **shall prepare** Multimodal Friction Ignition Test samples according to EM10-OWI-CHM-042, *Test Sample Preparation for Testing in Building 4623.* When non-standard samples are received, the *sample preparation technician* **shall follow** the directions written in the test plan for that test request. *If this information is not provided with the test plan*, the *sample preparation technician* **shall seek clarification** from the test engineer.

Before testing begins, the *test operator* **shall review** the information supplied on the test data sheet (prepared by the sample preparation technician) to make certain the information is complete and appears sound. *If a problem is identified*, the *test operator* **shall notify** the test engineer. The *test operator* shall also*:*

- **Verify** that the test request number and material designation are identical on all paperwork.
- **Confirm** that the prepared samples agree with the test request.
- **Verify** that the sample preparation technician has noted if the sample has been cleaned or if the sample does not need to be cleaned.
- **Note** any flaws or imperfections in the sample, and **record** these on the test data sheet.
- **Review** the signed test plan and the original test request before proceeding. *If the test plan and the test request do not agree*, **request** clarification from the test engineer.

## 4.2 Pre-Test Photography

The *sample preparation technician* **shall take** a pre-test photograph of at least one of the samples and **place** three copies of the photograph in the test folder. *If the pre-test photograph has not been taken*, the *test operator* **shall take** the photograph and **place** three copies of the photograph in the test folder before proceeding with the test. The entire sample shall be visible in the photo. Steps for photographing samples are outlined in the *Photography Operating Guide*.

## 4.3 Equipment Checkout

At the beginning of the test day, the *test operator* **shall perform** the following steps:

4.3.1. **Observe** at the oxygen monitor station located in Room 116. **Locate** the monitor for Room _____. **Ensure** that the digital LED readout indicates a normal oxygen level (19.5 to 23.5%) before entering the test cell.

4.3.2. **Ensure** that the test cell floor and the room behind the test cell are visibly clean. *If conditions warrant*, **scrub** the floor of the cell with a detergent solution, and **rinse** with water.

4.3.3. **Inspect** the sapphire sight glass(es) for cracks.

- Visually **inspect** windows from the outside using flash light or other light source.
- **Check** for cracks and scratches.
- **Check** door static face seal for deformation or protrusions.
- **Report** problems to the test engineer.
- **Inform** the test engineer before replacing damaged components.

4.3.4. **Inspect** all system hardware for cleanliness

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4.3.5. **Inspect** cables and electrical interface for wear, wetness, damage, or other deterioration. **Replace** items if wear, damage, or deterioration is evident.

4.3.6. **Inspect** monitors, cameras, video cassette recorders (VCRs), and the character generator to ensure that they are operational.

4.3.7. **Verify** that the facility oxygen supply is operational.

4.3.8. **Ensure** that the the facility warning beacon is operational.

## 4.4 System Setup and Sample Loading

The *test operator* **shall perform** the following steps:

4.4.1. **Inspect** the contents of the current test folder to ensure that the following information is provided:

- Test request
- Signed test plan
- Test data sheets
- Sample preparation sheet

- Test material's MSDS or the Exclusion Statement for the material/component being tested
- Pre-test photographs (**See** section 4.2.)
- Multimodal Friction Ignition Tester Pre-Test Checklist.

**WARNING: Read the test material's MSDS to ensure familiarity with all safety precautions associated with the material. Verify** that the test engineer is aware of all highly hazardous, reactive, or toxic components of the test material. The *test engineer* shall direct the test operator in proper safety procedures concerning these test materials.


4.4.2. **Turn on** warning lights to indicate that hazardous testing is in progress. This places the test area in a *limited-access* condition.

4.4.3. **Don** PPE (safety shoes, safety glasses, _____).

4.4.4. **Obtain** a blank 120-min tape from the facility supply, as needed, *i.e.,* if 5 minutes or less remain on the current tape. **Place** the tape in the tester VCR.

**Note:** Most VCRs are equipped with an automatic rewind/advance feature that is designed to rewind the tape back a few seconds after a tape has been inserted. **Play** a prerecorded tape for a few seconds to ensure the next recording does not record over a previous test.

4.4.5. **Type** the test sample information (test number, pressure, and sample) on the monitor screen using the Panasonic® Character Generator. (Section 7.1.xx contains instructions on using the character generator.) **Ensure** the date and time are correct on the Date/Time generator. *If not,* **refer** to the Panasonic® manual for that model to set time and date.

## 4.5 Detailed Test Procedure

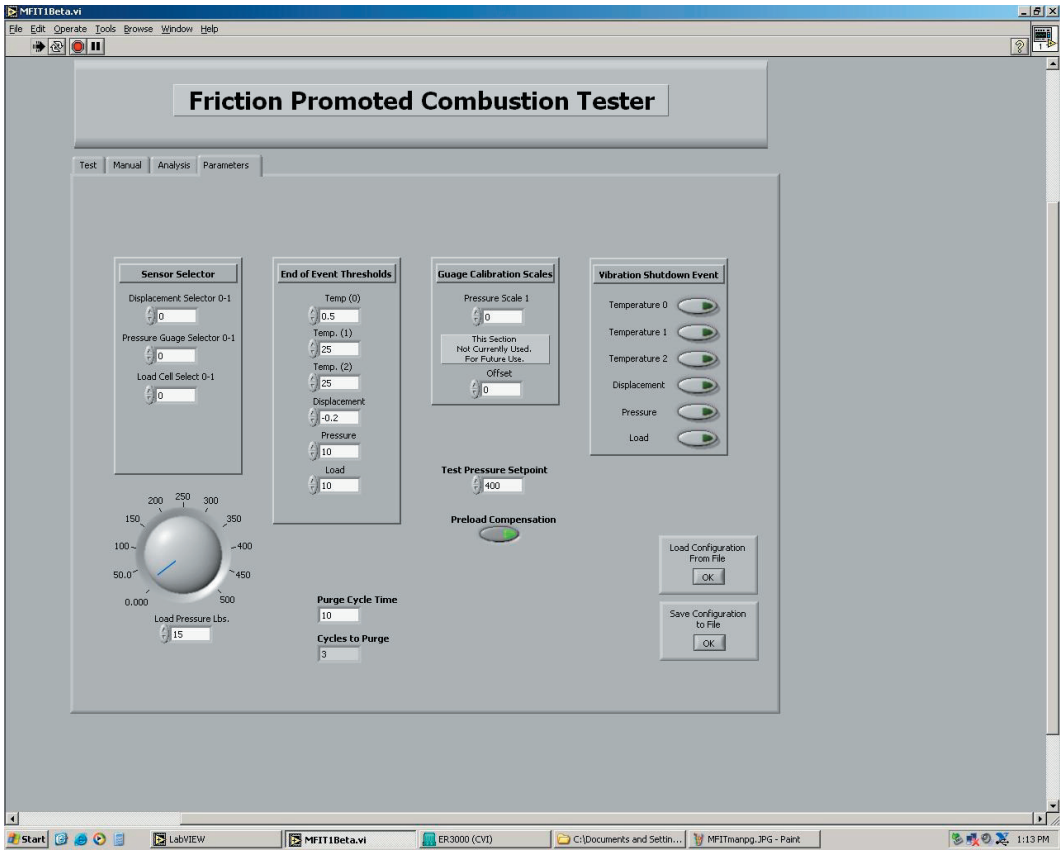
The *test operator* **shall perform** the following steps:

4.5.1. After completing system setup and sample loading, **power** on computer, and **double click** the MFIT.vi icon. *If necessary,* **select** the PARAMETERS tab (Figure 4-1).

4.5.2. **Run** the vi by selecting the RUN ARROW located just below the Windows EDIT pull-down menu. **Allow** the vi to continue to run from this point forward.

4.5.3. **Select** the LOAD CONFIGURATION FROM FILE button. (Instructions for creating a configuration appear in section 7.xx.)

Figure 4-1.
Typical MFIT Parameters Window




4.5.4. **Choose** the desired test configuration. **Modify** the configuration as necessary by usng the labeled control features.

4.5.5. **Power** the Vibration Exciter power amplifier by pressing the blue ON button located in the top left corner of the amplifier cabinet.

4.5.6. **Toggle** the TEST CELL VALVE POWER SUPPLY switch located on the top front panel of the 19-in. rack mount instrumentation cabinet to the ON position.

4.5.7. **Open** the gaseous nitrogen ($GN_2$) supply valve located on the east wall of the test cell, and **adjust** the downstream regulator to 100 psig.

4.5.8. **Open** the gaseous oxygen (GOX) supply valve located on the east wall of Room 124C and upstream of the GOX regulator panel.

4.5.9. **Regulate** the GOX panel outlet pressure to the desired test pressure.

4.5.10. **Verify** that a thermocouple is mounted in the slip block and the pressure block and that their tips are lying in or are aligned with their respective mounting groove.

4.5.11. **Mount** a test sample onto the sample pressure block and a second sample onto the slip block.

4.5.12. **Close** the chamber access hatch, **secure** it with the four hatch dogs, and **apply** the resulting torque value calculated from the following formula (see attachment drawing) expressed in in.-lb to each 1-in. diameter grade 8 socket head cap screw dog fastener. (Additional details about the torque formula appear in section 7.xx.) **Apply** torque in a typical cross torque strategy.

F = 14.25 (X)
F' = F LB x 3.6 in./1.25 in. = lb prying force on bolt (lb)
Minimum torque (in.-lb) = 0.2 x F' x 1 in. (bolt diameter)

where:
X = chamber test pressure
F = tensile force on each bolt
F' = prying force on each bolt.

4.5.13. At the LabVIEW™ vi, **select** the MANUAL tab (Figure 4-2). In the MANUAL window, **select** the O2 SUPPLY virtual button to open the oxygen ($O_2$) Remote Operations Valve (ROV) and flow $O_2$ into the chamber. **Select** the VENT virtual button to close the chamber vent ROV. **Observe** the Sensotec digital readout.

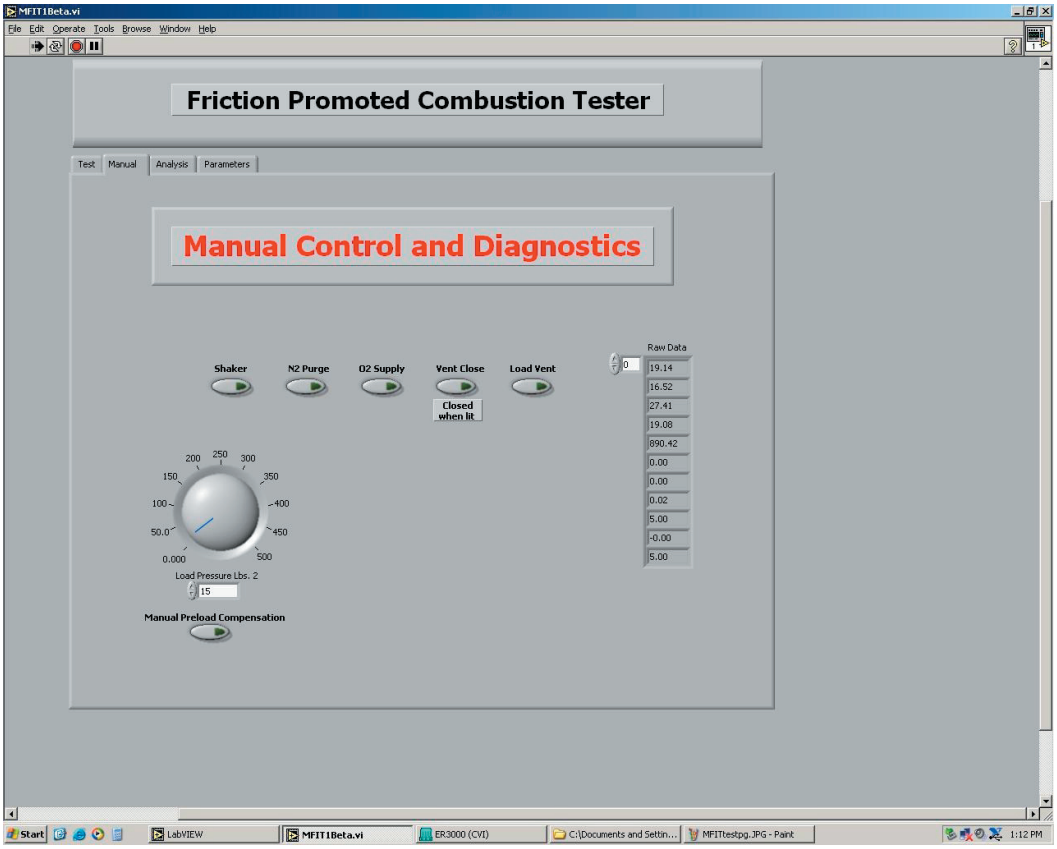


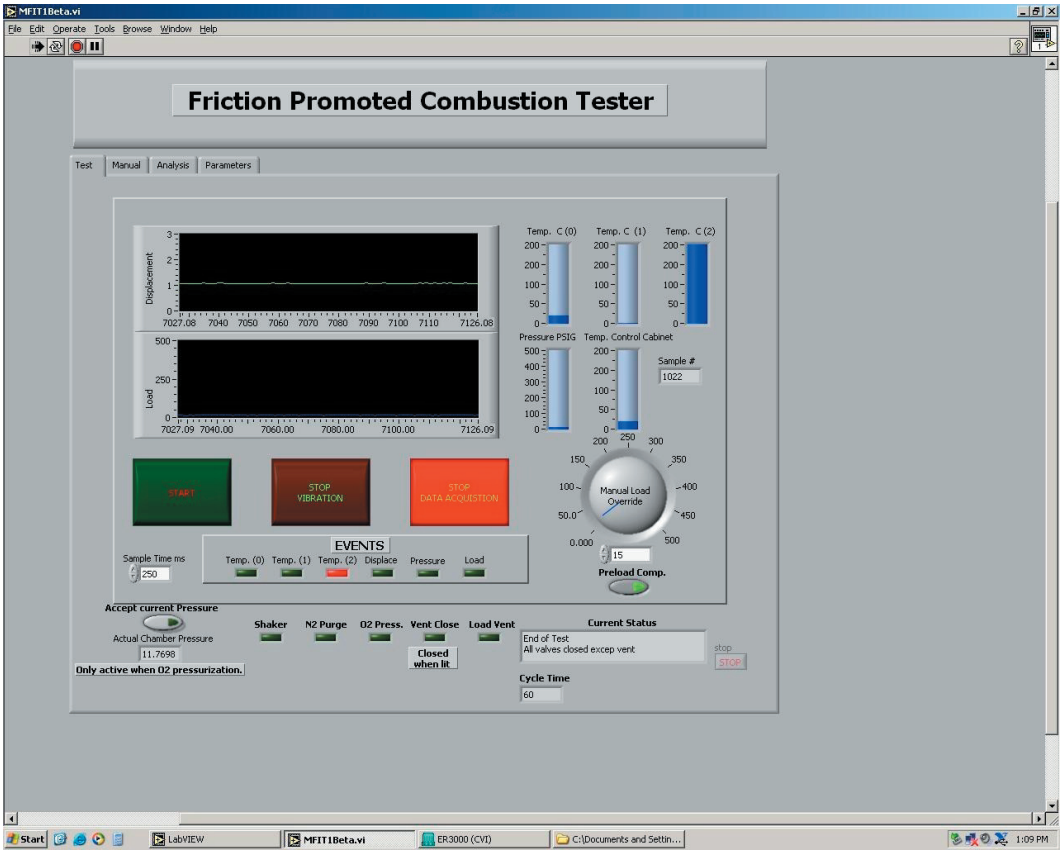

Figure 4-2.
Typical MFIT Manual Window

4.5.14. **Adjust** the $O_2$ regulator at the GOX regulator panel, and manually **cycle** the chamber vent valve until the chamber pressure is stabilized within ±5psi of the desired test pressure.

4.5.15. **Select** the O2 SUPPLY virtual button to shut the $O_2$ ROV. **Select** the chamber VENT virtual button to open the chamber vent ROV.

4.5.16. At the LabVIEW™ vi, **select** the TEST tab (Figure 4-3).

Figure 4-2.
Typical MFIT Test Window




4.5.17. **Select** the virtual START button. This will initiate the filling and venting of the test chamber first with $GN_2$ and then with GOX a predetermined number of times to ensure that the pressurized chamber environment is at 100% GOX.

4.5.18. When prompted to do so by the LabVIEW™ program, **press** the green OPERATE button located in the top left corner of the vibration exciter power amplifier cabinet, and **increase** the amplifier gain to the predetermined level that produces the desired slip block displacement. (Section 7.1.x describes the procedure for vibration parameter setup.)

4.5.19. **Press** OK in the message window. The load will be applied and the shaker will begin to run.

4.5.20. **Monitor** the displacement of the slip block on the video monitor. *If material*

*shedding begins to affect the displacement,* **increase** the shaker amplifier gain until the desired displacement is again achieved.

4.5.21. When the desired test time is reached, **stop** the test by selecting the STOP DATA ACQUISITION virtual button. This will stop the vibration, relieve the test sample load, open the chamber vent valve, and begin purging the chamber with $GN_2$. At a predetermined time, the purging will cease, and the program will prompt the operator to place the vibration exciter power amplifier in the standby mode.

4.5.22. **Turn** off the power amplifier gain by rotating the gain potentiometer counterclockwise. **Press** the yellow STANDBY button located in the top left corner of the amplifier cabinet.

4.5.23. **Observe** the Sensotec digital readouts located in the 19-in. rack mount cabinet to **verify** that the sample load is 0 ft-lb (±5 ft-lb) and that the chamber pressure is at local atmospheric pressure.

4.5.24. **Open** the chamber door, and **remove** the test samples, recovering as much of the shed material as possible from the chamber interior.

4.5.25. Repeat steps 4.5.10 through 4.5.24 for subsequent test samples.

## 4.6 Shutdown Procedure

The *test operator* **shall perform** the following steps:

4.6.1. **Secure** the test system by regulating the GOX and $GN_2$ supplies to 0 psi and closing their respective isolation valves.

4.6.2. **Toggle** the TEST CELL VALVE POWER SUPPLY switch located on the top front panel of the 19-in. rack mount instrumentation cabinet to the OFF position.

4.6.3. **Press** the red OFF button located in the top left corner of the shaker power amplifier cabinet.

## 4.7 Data Recording and Reduction; Post-Test Photography

The *test operator* **shall perform** the following steps:

4.7.1. Using a thumb drive, **transfer** the data from the Windows® notepad program to an Excel® spreadsheet at the operator's work station.

4.7.2. **Forward** the spreadsheet data to the test engineer.

4.7.3. **Complete** the test report data sheets (section 7.2, Figure ___). **Place** these sheets and the completed Pre-Test Checklist (section 7.2, Figure ___) in the test folder.

4.7.2. **Photograph** reacted samples. **Document** these in writing on the test report data sheet. **Do not photograph** post-test samples that did not react. **Take** photographs as close to the samples as possible. More than one sample or reaction per photograph is acceptable, if the details of reactions are visible. **Refer** to the *Photography Operating Guide* for procedures for taking photographs. **Place** three copies of each post-test photograph in the test folder before returning the folder to the engineer. Photographs shall be retained indefinitely.

> **Note:** *If there are several reactions and samples are hard to handle,* representative photos may be taken and labeled as such. The test engineer, in consultation with NASA, **shall decide** whether to make representative photos on a case-by-case basis.

**Package** samples in clear photography slide sleeves. **Label** the protector with the test request number, (standard) test type, temperature at which the test was performed, reactions per number of samples tested, pressure at which the test was performed, and the date. **Use** a red pen to label reacted samples; **use** a black pen to label all other samples. **Identify** the sample by sample number. **Return** the samples with the test folder to the test engineer for evaluation. The *test engineer* **shall return** samples to the *sample preparation technician* who **shall store** them for future reference.

# 5.0 Notes

| Custodians for EM10-OWI-CHM-089 | |
|---|---|
| Master List and Document Control | EM10 Management Support Assistant |
| Alternate Document Control | EM10 ISO Representative |
| Records | Materials Test Branch ISO Representative |
| Calibration | Materials Test Branch Calibration Contact |
| Memoranda | Materials Test Branch ISO Representative |

# 6.0 Safety Precautions and Warning Notes

## 6.1 Hazards

**Warning**
Death, severe personal injury, or loss of major equipment may result if maintenance or operating procedures, techniques, restrictions, etc., are not followed exactly.

**Safety shall have precedence over all activities.** Because of the nature of testing materials in a GOX environment, the testing system involves several hazards to the operator and facility. Personnel conducting Multimodal Friction Ignition Testing may be exposed to the following hazards:

- Exposure to an oxygen-deficient environment
- Flammability and health risks from volatile cleaning solvents
- Potential of explosion and hazardous fume by-products from burning materials in a pure oxygen or oxygen-enriched environment
- Pressurized systems with nitrogen.

## 6.2 Safety Precautions

6.2.1. Personnel shall **plan** test setup, testing, and shutdown so that at least one test operator is in the test area and one other person is in Building 4623 during normal business hours. After normal business hours and on weekends, a test engineer shall be in Building 4623 during all test activities. **No more than five personnel** shall be in the test area at any given time. Operation of tests shall comply with EM10-OWI-CHM-050, *Building 4623 Guidelines for Test Operations*.

6.2.2. When personnel are working with the tester, the controls **shall not be operated**. A sign warning that personnel are working in the test cell shall be placed on the control console.

6.2.3. Personnel shall **refer to the MSDS** for information on personal protective equipment for materials being handled (sample materials, solvents used, gases, *etc.*). Personnel **shall wear** safety apparel appropriate for test specimens and conditions:

- Safety shoes when there is a danger of foot injuries from falling or rolling objects, objects piercing the sole of the shoe, or when feet may be exposed to an electrical hazard
- Clean laboratory coats when working with enriched oxygen or other oxidizers, combustion by-products, compressed gases, or flammable solvents
- Chemical goggles and gloves while cleaning test equipment and while working with solvents
- A respirator when working with solvents in closed or poorly ventilated spaces. **Note** that the appropriate respirator shall be worn as indicated on the MSDS. Cartridge respirators are only good for the constituents listed on the filtration cartridge and for dust particle filtration. Personnel shall be qualified to use the respirator, and the respirator shall be supplied by MSFC.

- Safety glasses at all times while in the test cells.

6.2.4. **Smoking is not permitted** in Building 4623. Personnel **shall not smoke or expose clothing** to an open flame for 30 minutes after handling liquid or gaseous oxygen.

6.2.5. The building warning system **shall be activated** for the duration of all testing, including pre- and post-test procedures. Personnel **shall evacuate** the test area immediately when the oxygen alarm sounds and lights flash.

6.2.6. Nothing shall be stored in the test cell area other than parts or components of the testing apparatus that are designated as spare parts and the tools necessary for routine equipment maintenance. All other materials shall be removed from the test area and spare equipment placed in labeled cabinets or shelves for adequate inventory and access..

6.2.7. Personnel shall know the location of all the safety eyewashes, showers, and fire extinguishers inside and outside the test area.

6.2.8. All testing shall be performed **remotely**. The control console **shall be staffed** continuously during all testing activities and remotely controlled processes.No one **shall be allowed** in the test cell , associated areas behind or adjacent to the test cell, the fenced area behind the test cell, or the roof above the test cell when the chamber is pressurized above 500 psig. Only the test operator(s) **shall be allowed** in the test cell during pre-test and post-test activities. **Open** the roll-up door behind the test cell at any time the pressure exceeds ambient in the test chamber.

6.2.9. A pressure relief valve and a burst disk are incorporated in the safety protection of the test chamber. The pressure relief valve set point is 650 psig, and the burst disk rating is set at 770.37 psig. These settings are based upon the maximum working pressure of the chamber being 600 psig.

6.2.10. Oxygen-deficiency alarms are located throughout the building. When an oxygen-deficiency alarm sounds, all personnel **shall evacuate** from the immediate area and **notify** security and supervisors. Personnel **shall** call 4-4357 (4-HELP), and then **press** 1 to notify security.

6.2.11. Personnel shall **ensure** all electrical components, wiring, *etc.,* are in good condition and properly connected and grounded and shall **use caution** when operating any electrical equipment. Electrical devices shall not be operated when floors in the test cell are wet.

6.2.12. Personnel shall purge the test chamber with nitrogen and then equalize to ambient atmospheric pressure before opening.

6.2.14 When handling cylinders and dewars or making connections for compressed gases and/or liquids, personnel shall **refer** to *Working Safely with Compressed Gases and Cryogens* and *NSTC 313-Cryogenics Safety* and shall **comply** with the suggestions inside these presentations. (The test engineer has these resources.)

6.2.15. The building warning lights **shall be checked** daily for proper operation.

## 6.3 Special Hazards Associated with Compressed Gases and Liquids

6.3.1. All operations involving compressed gases and liquids shall be conducted with at least 2 people, in visual contact, in the facility.

6.3.2. All operating personnel shall be instructed on the nature of hazards associated with compressed gases and liquids.

6.3.3. Before removal of any component of the system for servicing, the *operator* **shall secure and inspect** the system to ensure that no unsafe condition exists.

6.3.4. Personnel shall perform continuous monitoring, *e.g.,* check operating pressures, look for leaks, listen for unusual noises, during all operations. Personnel shall ensure that oxygen leak levels are adequate throughout operations.

## 6.4 Emergency Shutdown Procedure

**Select** the STOP DATA ACQUISTION virtual button located on the virtual test control panel. This will stop the vibration exciter, shut the $O_2$ supply valve, dump the pressure in the chamber, open the $N_2$ supply valve that will immediately begin to purge the test chamber, and relieve the load on the test sample.

**Note:** Placing the TEST CELL VALVE POWER SUPPLY toggle switch located on the top front panel of the 19-in.rack mount instrumentation cabinet to the OFF position will atmospherically safe the test chamber but will not shut down the vibration exciter.

## 6.5 Accident Reporting

6.5.1. From a safe location, the *test operator* **shall call 911 immediately** and **notify** the EM10 Branch Chief.

6.5.2. From a safe location, the EM10 Branch Chief **shall immediately report** the accident to the NASA Safety Monitor and the appropriate supervisor(s).

## 6.6 Emergency Response Plan

Emergency procedures and plans for Building 4623 are incorporated into this OWI and are stated in MPR 1040.3, *MSFC Emergency Plan,* current revision. Plans shall be modified if operations change in a significant manner.

## 6.7 Mishap Reporting

All mishaps occurring in Building 4623 **shall be reported** to the test engineer, who shall report the mishap to the Building 4623 Safety Monitor. An initial verbal report **shall be made** within 8 hours, followed by a written report within 3 days. The EM10 Branch Chief **shall prepare** a managerial report within 7 days. Both reports **shall be reviewed** by the test operator's supervisor and by the NASA Safety Monitor. The detail and extent of the mishap report **shall** depend on the nature and extent of the damage. *If personnel injury or equipment damage does occur*, the mishap report **shall** be completed in accordance with MWI 8621.1, *Close Call and Mishap Reporting and Investigation Program, current revision*.

# 7.0 Attachments, Data, Reports, and Forms

## 7.1 Attachments

7.1.1. Creating a Test Configuration

7.1.1.1. **Power** on computer.

7.1.2.2. **Select** the MFIT1BETA vi.

7.1.2.3. **Run** the vi by selecting the RUN ARROW located just below the Windows® EDIT pull-down menu. **Allow** the vi to continue to run from this point forward.

7.1.1.4. **Select** the PARAMETERS tab. **Reference** Figure 7.1 for the following discriptions:

- SENSOR SELECTOR: **Leave** all three sensor selector channels set to 0 unless more than one of the same sensor is used in the future.
- END OF EVENT THRESHOLDS: These are event limits that work in conjunction with VIBRATION SHUTDOWN EVENT buttons and will shut down the vibration portion of the test but will allow the LOAD, CHAMBER PRESSURE, and DATA ACQUISTION to continue to run until a command is given to stop the test.
- GUAGE CALIBRATION SCALES: Not used.
- VIBRATION SHUTDOWN EVENT: A particular sensor event, determined by whichever of the virtual buttons is illuminated, will shut down the shaker depending upon the END OF EVENT THRESHOLDS sensor setpoint.
- TEST PRESSURE SETPOINT: **Type** in the required test chamber pressure (600 psig max).
- PRELOAD COMPENSATION: Active when illuminated. Works in conjunction with LOAD PRESSURE LBS. Uses an algorithm to apply additional force to the sample load cylinder to offset the effect of the chamber pressure on the LOAD SHAFT.
- PURGE CYCLE TIME: Chamber fill and dump cycle time (in seconds) before pressurizing chamber to final test pressure.
- CYCLES TO PURGE: Cannot change. Information only.
- LOAD PRESSURE LBS: Sample load setting. Can type in number (best) or use knob. During test, the display pressure will include this number and the addition of the PRELOAD COMPENSATION factor and will depend on the chamber pressure at the time of the observation.
- LOAD CONFIGURATION FROM FILE: Used to retrieve and load a previously saved set of PARAMETERS.

**Note:** There is always a default PARAMETER file that will load when the vi is stopped and then started again. **Take care** to verify the values in the PARAMETERS tab when starting and stopping the vi.

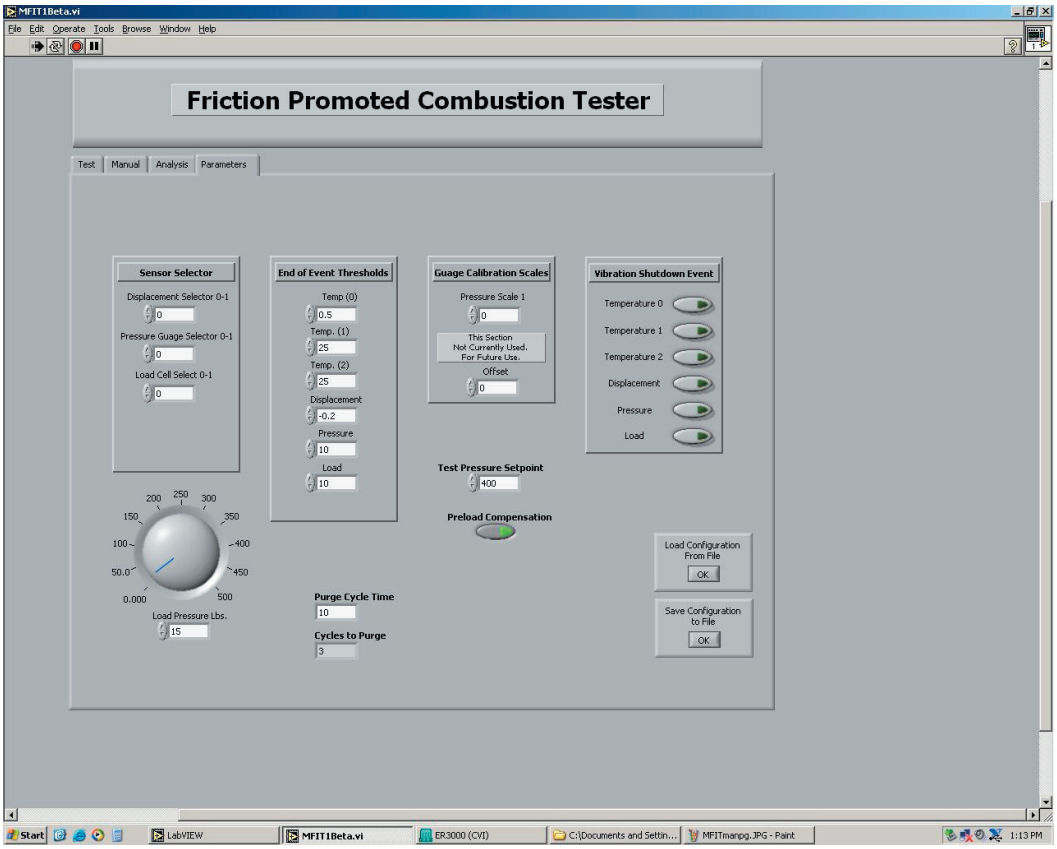



Figure 7-1.
Typical MFIT Parameters Window

- SAVE CONFIGURATION TO FILE: Saves the current configuration to file.

## 7.1.2. Torque Formula

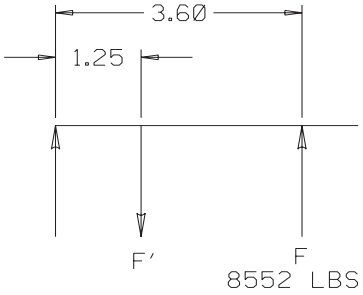



Figure 7-2.
MFIT Torque Formula

$$F = \text{ORING DIA}^2 \times p_1/4 \times \text{PRESSURE} \times \tfrac{1}{4}$$

$$F = 8.52^2 \times p_1/4 \times 600 \text{ PSI} \times \tfrac{1}{4} = 8552 \text{ LBS}$$

$$F' = \frac{8552 \text{ LBS} \times 3.6 \text{ IN}}{1.25 \text{ IN}} = 24630 \text{ LBS}$$

PRYING FORCE ON THE BOLT

$$\text{TORQUE} = .2 \times F' \times \text{BOLT DIAMETER}$$

$$\text{TORQUE} = .2 \times 24630 \text{ LBS} \times 1 \text{ IN} = 4926 \text{ IN-LBS}$$

MINIMUM TORQUE

7.1.3. Vibration Parameter Setup

7.1.3.1. **Acquire** the vibration test parameters from the test engineer.

7.1.3.2. **Connect** the output of the Wavetek VCG/Noise Generator to the Tektronix® oscilloscope channel "A" input and the vibration input channel of the National Instruments SCXI chassis.

7.1.3.3. **Connect** the National Instruments SCXI chassis vibration output to the vibration exciter's power amplifier SINE tap input BNC connector located on the front of the power amplifier. **Select** the SINE input tap by positioning the tap selector toggle switch to SINE.

7.1.3.4. **Power** on the National Instrument's SCXI chassis using the ON/OFF rocker switch located on the front of the chassis.

7.1.3.5. **Verify** that the vibration exciter's power amplifier is either OFF or is in the standby mode as indicated by the illumination of the yellow STANDBY button and that the AMP GAIN potentiometer is in the fully counterclockwise position.

7.1.3.6. For a discrete sinusoidal frequency dwell, **refer** to the Wavetek Instruction Manual, and **use** the following operating controls of the Wavetek VCG/Noise Generator:

FREQ HZ/PWR OFF knob
FREQUENCY DIAL
FUNCTION SELECTOR
OUTPUT ATTEN (db)
FUNC mode button
50Ω OUT connector.

7.1.3.7. **Set** the six aforementioned controls:

- **Turn** Wavetek on by rotating the FREQ HZ/PWR OFF knob to one of the six decade ranges. **Verify** that the FREQ VERNIER is rotated fully counterclockwise.

- **Set** the FREQUENCY DIAL to the desired frequency increment by aligning it with the FREQUENCY INDEX. This setting is multiplied by the decade setting in the previous step. For example ,*if the decade range is set to X10 and the frequency dial is set to 1.0 Hz*, then the resultant frequency output will be 10 Hz.

**Caution:** The vibration exciter's maximum frequency response is 1 KHz. Severe damage could occur to the shaker armature *if this limit is exceeded for*

*an extended period of time or the frequency setpoint is inordinately excessive even for few seconds.*

- **Set** the FUNCTION SELECTOR to the sine wave position.
- **Rotate** the OUTPUT VERNIER (db) to the fully clockwise position.
- **Set** the OUTPUT ATTEN (db) to -30.
- **Depress** the FUNC button so that it remains in the depressed position.

7.1.3.8. **Power** on the Tektronix® oscilloscope. **Set** the time and amplitude such that the wave form resolution generated by the Wavetek is easily readable. This is not a data source but is for verification of the Wavetek signal output.

7.1.3.9. **Raise** the load shaft fully up, and **block** in place to prevent engagement with the slip block.

7.1.3.10. **Attach** the vibration exciter's ambient pressure centering springs to the shaker armature shaft by hooking them into the two holes drilled into the 5/16-in. flat washer mounted at the interface of the armature shaft and the adapter shaft.

**Note:** These springs simulate the chamber pressure pushing out on the slip block shaft. They are removed during chamber pressurization as the combination of the springs and the chamber pressure acting on the shaft would force the slip block too far toward the pull position.

7.1.3.11. At the power amplifier, **press** the green OPERATE button. **Do not increase** the power amplifier gain.

7.1.3.12. At the LabVIEW™ vi, **select** the MANUAL tab.

- **Set** the LOAD to "0".
- **Ensure** that the PRESSURE COMPENSATION virtual button is set to OFF (not illuminated).
- **Select** the SHAKER virtual button to turn it ON (illuminated).

**Note:** No shaker movement will take place until the power amplifier gain is increased.

7.1.3.13. While observing the sample slip block on the video monitor, **slowly increase** the power amplifier GAIN until slip block movement is detected [around 50% of gain travel with WAVETEK OUTPUT ATTEN set at -30

and OUTPUT VERNIER (db) set at 0].

7.1.3.14. **Continue** to increase the power amplifier GAIN until the desired slip block displacement is achieved as indicated by the vibration displacement wedge mounted on the side of the slip block directly in camera view.

7.1.3.15. *If the desired displacement is unachievable at full scale power amplifier gain,* then:

- **Turn** power amplifier GAIN to the fully counterclockwise position; **leave** other settings as is.
- **Set** the WAVETEK OUTPUT ATTEN to -20.

7.1.3.16. **Increase** the power amplifier GAIN until the desired slip block displacement is achieved.

7.1.3.17. **Index** the gain position by placing a mark on the tape that encircles the gain potentiometer.

7.1.3.18. **Select** the SHAKER virtual button in the LabVIEW™ vi to turn off the shaker.

7.1.3.19. **Turn** power amplifier GAIN to the fully counterclockwise position.

7.1.3.20. **Press** the power amplifier's yellow STANDBY button.

## 7.2 Forms

Figures 7-3 and 7-4 are typical forms used in support of Mulimodal Friction Ignition Testing.

## Multimodal Frictional Tester Pre-Test Checklist

**Request No.** _____

Initial

1. ____ NASA-STD-6001 reviewed within the last year?
2. ____ Multimodal Friction Tester OWI reviewed within the last year?
3. ____ Equipment reflects baseline in OWI?
4. ____ Equipment checked out per OWI?
5. ____ Samples wiped clean before loading into test chamber?
6. ____ Adequate supply of gaseous oxygen?
7. ____ Chamber wiped to visually clean?
8. ____ Facility warning beacon activated?
9. ____ Sample MSDS read?
10. ____ Pre-test photographs taken and in test folder?

Refer to 6001?

Remarks/Discussion of Discrepancies:

_____

_____

_____

_____

_____

_____

_____

_____

_____ _____

Test Operator Date

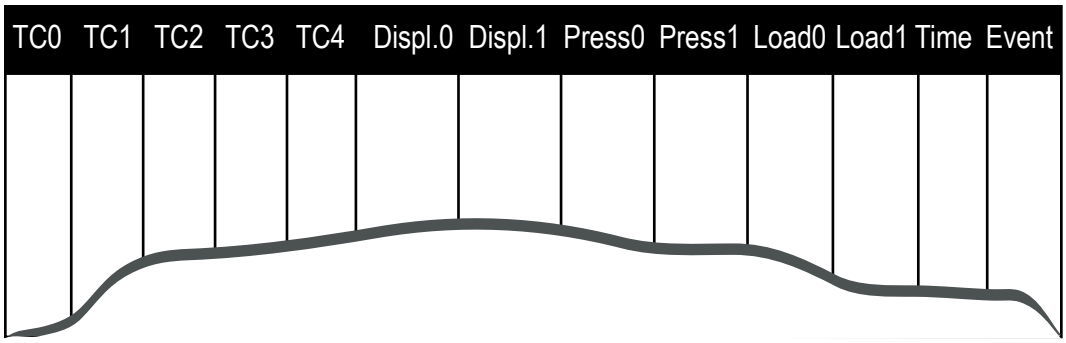
x/200x EM10-F-CHM-0xx

Figure 7-3. Typical Multimodal Friction Ignition Tester Pre-Test Checklist.

Note: Representative Data Sheet. Refer to Forms Master List for current version.

Figure 7-4.
Multimodal Friction Ignition Tester Test Data Sheet

To be updated with MAPTIS test data sheet for MFIT when this is created.



# 8.0 Records

Records for the Multimodal Friction Ignition Test **shall consist** of memoranda that contain test results and that are stored electronically in the Materials and Processes Technical Information System (MAPTIS).

## 8.1 Memoranda

Memoranda containing test results **shall be retained** indefinitely by EM10. These memoranda **shall be stored** electronically in the MAPTIS database and **shall be accessible** by test request number or memorandum number.

## 8.2 Calibration Records

All equipment requiring calibration **shall be** in current calibration, in accordance with EM10-OWI-CHM-050, *Building 4623 Guidelines for General Operations.*

## 8.3 Maintenance of Records

8.3.1 Memoranda less than 10 years old **shall be maintained** in ready-access files in MAPTIS; memoranda 10 years old or older **shall be transferred** automatically to historical files.

8.3.2. Calibration records **shall be maintained** on site for a minimum of 10 years, filed and indexed by test request number. These **shall be stored** in a manner that will protect them, *e.g.*, in a test folder stored in a metal file cabinet. After 10 years, calibration records **shall be transferred** to historical files.

8.3.3. The original test records **shall be saved** for a minimum of 5 years.

# 9.0 Tools, Equipment, and Materials

## 9.1 Standard Configuration of Tester

Add descriptive words to accompany Figure 9-1.

## 9.2 Procedure for Deviations

Deviations to the baselined tester configuration **shall have** NASA written approval. It is the responsibility of the test engineer to obtain the written approval. After written approval is received, the change shall be added to the *Multimodal Friction Ignition Tester Configuration Control Book*.

## 9.3 Required Tester Maintenance

The standard maintenance program for this test chamber and related control equipment is divided into weekly and as-required service. In addition, the program involves a maintenance log, calibration, and a required spare parts inventory. The test operator shall perform the following procedures:

9.3.1. Weekly Maintenance. TBD

9.3.2. As-Required Maintenance TBD

9.3.3. Maintenance Log. **Document** any maintenance to the test chamber or setup in the *Multimodal Friction Ignition Tester Maintenance Log* to provide a history of the tester. Any deviation to standard maintenance shall be documented by the test operator and approved on the maintenance log by the responsible test engineer.

## 9.4 Calibration

TBD

## 9.5 Required Spare Parts Inventory

**Verify** that the spare parts listed in Table 9-1 are available at the beginning of each test request, so that the testing of a material can be completed as close to within 1 working day as possible.

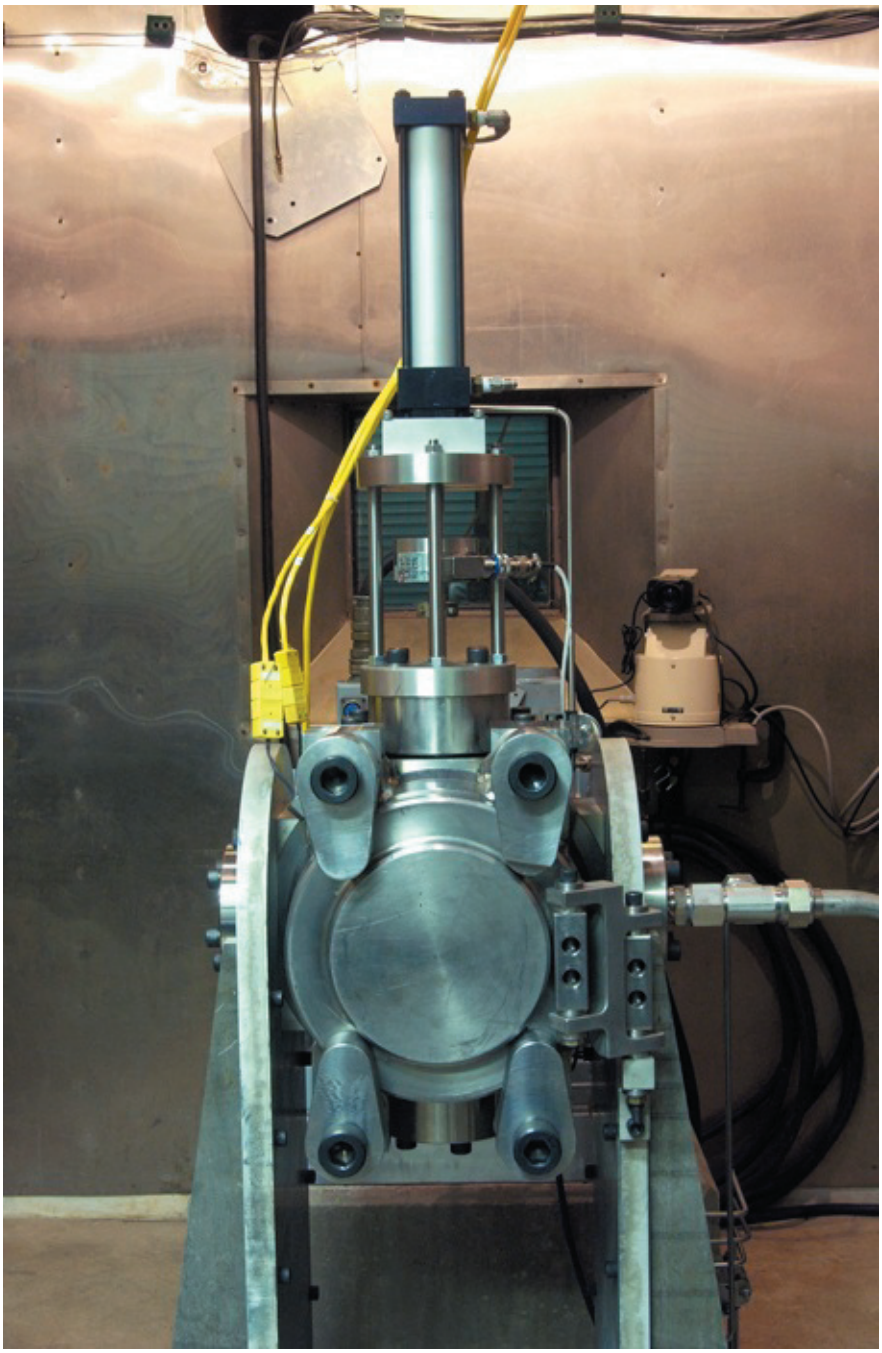


Figure 9-1.
Multimodal Friction Ignition Tester.

Want to add any labels or callouts?

Table 3.
Required Spare Parts Inventory for Multimodal Friction Ignition Tester

| Part | Quantity | Drawing #/Description |
|---|---|---|
| TBD | | |

# 10.0 Personnel Training

The nature of testing that occurs in Building 4623 is complex and involves potential hazards; therefore, all test operators shall complete the requirements for Category 1 Credentials before conducting any test, and all tester maintenance personnel shall complete the requirements for Category 2 Credentials.

- **Category 1 Credentials** qualify personnel to perform basic test operations.
- **Category 2 Credentials** qualify personnel to maintain and modify testing apparatus.

## Category 1 Credentials - Basic Operations

To obtain Category 1 Credentials, the test operator shall complete training in following areas:

- High-Pressure Systems Safety
- Oxygen Compatibility
- General Safe Laboratory Practices
- Safe Handling of Cryogenic Fluids ($LN_2$ and LOX)
- Hazardous Waste Disposal.

**Category 1 Credentialling** also requires:

- Successful completion of an annual physical examination conducted by the medical facility at Marshall Space Flight Center (or equivalent), including a hearing exam
- A demonstration of knowledge of the test and equipment by the completion of two successful test sets under the supervision of the test engineer.
- A demonstration of knowledge of the OWI. Candidate test operators shall thoroughly read the test OWI and sign a statment confirming that they have read and understand the OWI. Each shall be issued a personal copy of the OWI.
- Passing of a written test covering the OWI. The test shall be administered by the test engineer.

A copy of the written test, along with the signed statement and the training record, shall constitute verification of credentials. Training records shall be kept on file as proof of training. These records shall include training expiration dates and required refresher courses.

Category 1 Credentials shall expire after a period of 2 years. After that time, recredentialling shall be required.

## Category 2 - Tester Maintenance and Modifications

Personnel seeking **Category 2 Credentials** shall become qualified and credentialled through training classes approved by the candidate's supervisor or through training classes completed during previous employment. Training in the following areas shall be required:

- Compressed Gases and Working with Compressed Gas Lines and Fittings
- Basic Electrical Wiring.

This training shall be achieved through classes approved by the candidate's supervisor or through classes completed during previous employment.

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## EMERGENCY PHONE NUMBERS

**Emergency..... 911**

**Medical Center..... 4-2390**

**Industrial Safety..... 4-0046**

**Chemical Spills..... 4-4357**

**Safety Monitor**
**Building 4623..... 4-3571**